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Traffic Lights Control with Adaptive Group Formation Based on Swarm Intelligence

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ABSTRACT

Traffic problems nowadays are increasing because of the growing number of vehicles and the limited resources provided by current infrastructures. On intersecting roads, huge number of vehicles leading to congestion and heavy traffic. Traditional traffic controls (warning signs, stop signs, etc.) are used in most areas but these are sometimes inadequate to address the problem. Since the expansion of the traffic network is no longer a socially attainable solution, the existing control systems have to be used in a more intelligent way in order to increase the traffic throughput and decrease total travel times.

In our project we are controlling traffic using 'SWARM intelligence'. Using SWARM intelligence makes the system decentralized i.e. no need of centralized control room. We are also displaying the traffic at next junction in the direction of travelling so that people aware about the traffic of next junction. The methods that are used in this project are design the circuit, write a coding, simulation, synthesis and implement in hardware. In this project, AVR studio Software was chosen to write assembly C coding and MATLAB is used to write coding for DIP part.

1. INTRODUCTION

Traffic congestions emerge as the main problem on the roads nowadays. They not only worsen the mood of travelers, but also have negative economical and ecological impact. Traffic simulation can be viewed as an easy and efficient way to predict the problematic areas on the roads. Additionally, traffic simulation is also a tool that suggests how the traffic situation can be improved. The two main approaches to simulate the traffic flow are to simulate it either on macro, or on micro level. A macro-model considers traffic flow as a fluid and does not take into account individual agents. A micro-model, on contrary, treats traffic flow as the result of the interaction between individual agents. However, recently new approaches to the treatment of micro-simulation are developed. One of the most promising ones, the swarm-based approach, is introduced here.

Swarm Intelligence provides the ability for decentralized systems of agents to create global behavior patterns. These patterns emerge from local modifications of the environment performed by each agent. A modification is consistent with the modifications done by other surrounding agents. A colony of ants can be taken as a good example. Ants have the ability to change the environment by leaving the pheromones, which other ants can sense and then make their decision based on the information received.

Swarm intelligence can be applied not only to the colonies of insects. Some social interactions among humans result in emergent patterns, as if influenced by swarm intelligence. One of such examples is the interaction between cars in the traffic flow. Cars in swarm-based traffic simulation, like ants, are also able "to drop and sniff the pheromones". The physical interpretation of pheromones is visual and perceptional signals send and received by cars, such as stopping and turning lights, acceleration, and deceleration.

2. PREVIOUS WORK TO IMPROVE TRAFFIC AND SAFETY

2.1 EXISTING SYSTEM

The most common way to control traffic is to deploy traffic lights at street junctions. A traffic light has three main lights: red, green, and yellow. Each light represents a traffic signal; red means "stop", green means "go", and yellow means "slow down" or "prepare to stop".

There are different ways of controlling a traffic light for it to change phase. The simplest way uses timer for each phase. Others use electronic sensors in order to detect vehicles, and produces signal that cycle. Some of the latest traffic light control systems use video cameras on intersections since it can accurately detect vehicles than using sensors.

2.2 DRAWBACKS OF EXISTING SYSTEM

This can solve safety problems, but at the same time causes a decrease of flow and an increase of travel times. In order to minimize the delays, several methods of traffic light control have been proposed.

Classic traffic engineering approaches for controlling traffic work well only in traffic networks with very well-defined traffic volume patterns, like for instance morning and afternoon peaks. However, in cities where these patterns are not clear, this approach may not be effective. This is the case in big cities where business centres are no longer located exclusively downtown. For these situations, more flexible approaches are needed.

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Classical traffic engineering approaches usually rely on linear programming. This is so because the alternative of using totally decentralized approaches could impose communication bottlenecks for the negotiation, and/or would require a traffic expert to mediate possible conflicts. Thus, more robust approaches than linear programming are not only attractive, but necessary.

2.3 STATEMENT OF THE PROBLEM

The problem with a pre-timed traffic light is that it remains green until the time expires even if there are no more vehicles waiting to pass the intersection, while the vehicles on different route still wait for their turn. This problem is solved by using electronic sensors to detect vehicles on the road. Sensor-based systems use coils of wires embedded in the road's surface.

However, by using this system, small vehicles like motorcycles and bicycles may not be detected because of their low metal content. Thus, signaling the traffic light to change state despite the latter's presence.

Additional problem is that when the loop wires become damaged, the signal controller of the system sometimes interprets damaged wires as presence of vehicles. A new system for controlling the traffic light by image processing is the main goal in this project.The system will detect vehicles through images instead of using electronic sensors embedded in the pavement. A camera will be installed alongside the traffic light. It will capture videos and convert them to image sequences. The image sequence will then be analyzed using digital image processing for vehicle detection.

2.4 SIGNIFICANCE

While waiting for the traffic light to change phase, motorists lose time, and vehicles consume more fuel. The system can reduce the waiting time of motorists since it minimizes (if not totally avoids) giving a green light to an empty road. It can also detect all kinds of vehicles in a more accurate basis. The traffic monitoring agency will also benefit because the system will lessen their expenses (Example: Instead of embedding electronic sensors under the pavement, only a video camera will be installed at the road side).

3. OBJECTIVES OF THE PROJECT

The study generally aims to create a system that would process road images during daytime only, and signal the result to a simulated traffic light system.

Specifically, it aims to do the following:

1) Display the traffic of next junction (whether LOW, MEDIUM or HIGH).

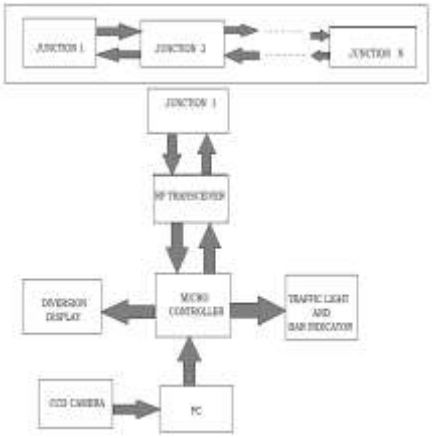
2) Distinguish the presence and absence of vehicles in road images.

3) Signal the traffic light to go green if the road is empty.

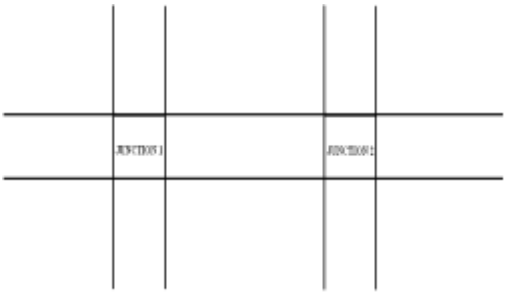
4) Signal the traffic light to go red if the maximum time for the green light has elapsed even if there are still vehicles present on the road.

4. METHODOLOGY

4.1 BLOCK DIAGRAM



4.2EXPLANATION:-



A camera will be mounted on the each lane of the signal on a junction. CCD Cameras will feed the video to a PC. A MATLAB based digital image processing will be done on the video frames to calculate the amount of traffic. The process of digital image processing is done in following steps.

1) Image acquisition:

One or several image sensor produces digital image. The image may be 2D or 3D from depending on the type of sensor used. Image sensor types include light-sensitive cameras, renge sensors, tomography devices, ultra-sonic cameras, etc.

2) Image Segmentation:

In the analysis of the objects in images it is essential to distinguish between the objects of interest and "the rest". This latter group is also referred to as the background. The pixels in the image will be converted into a series of 0's and l's. This can be done by getting the grayscale value of a pixel and comparing it to a certain pixel value. Segmentation lessens the area of concern and makes the system run faster.

3) Motion Tracking:

Can be off-line or real-time. In offline, the entire image sequence is stored. The tracking uses frame differencing algorithm to generate a motion map.

4) Background Subtraction:

The process of finding the transient objects by comparing the current frame to the background image.

5) Morphological Operations:

(i) Opening: Removes foreground details that are smaller than the structuring element. It is also used as a noise removal operator;

(ii) Closing: Removes background details–holes, gaps, inside corners, etc.–that are smaller than the structuring element. It is also used to link components (i.e., broken lines) that should be connected.

6) Image Correlation:

The process of computing the correlation for each region of interest (ROI) of the current image to the ROI of the background image.

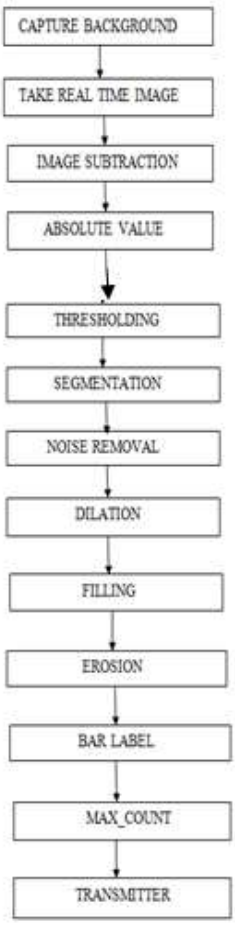
The system has three main phases: (1) Input generation, (2) Processing part, and (3) Output generation.

A. Input generation

This phase includes the whole data gathering part (capturing images on road).

B. Processing part

The overview of the system is illustrated in Fig below,



C. Output generation

After executing the processing part, the system creates a sequence of image processed output containing the results of the processing part and the simulation of the traffic light system as well.

If traffic will be found more on that particular lane using image processing ,that signal will be given to a microcontroller. Microcontroller will send this message to traffic light and bar indicator. Accordingly Bar indicator will show the Traffic of its next junction. Microcontroller will increase the on time of the green light on that signal as per the C-programming done in Microcontroller. Acting as a social insect (using swarm intelligence) traffic signal will send command to its previous junction using RF Transceiver. On the previous junction, traffic signal will divert traffic in alternate direction. Also Traffic signal will reduce the amount of traffic going on the next signal by reducing the on time of green light. This system is installed on each junction. Thus each junction is connected with its previous junction through RF Transceiver.

5. CONCLUSION:-

Using SWARM intelligence makes the system decentralized i.e. no need of centralized control room. We are also displaying the traffic at next junction in the direction of travelling so that people aware about the traffic of next junction. The methods that are used in this project are design the circuit, write a coding, simulation, synthesis and implement in hardware. In this project, AVR studio Software was chosen to write assembly C coding and MATLAB is used to write coding for DIP part.

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